



# NASA Undergraduate Student Research Program

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Goddard Space Flight Center  
Greenbelt, MD

Detectors Systems Branch  
Code 553

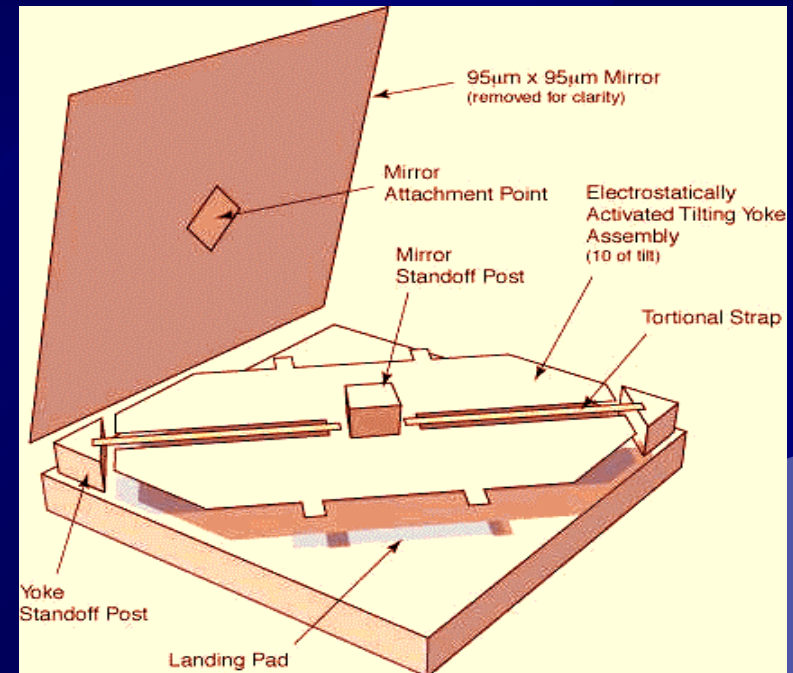


# MEMS Technology Development

Micro-Electromechanical Systems have become an extremely important area of technological advances. The conservation of power, light-weight devices, and cost of production are the driving reasons for its perusal. At the NASA Goddard Space Flight Center (GSFC) it is hoped to revolutionize imaging and spectroscopy systems.

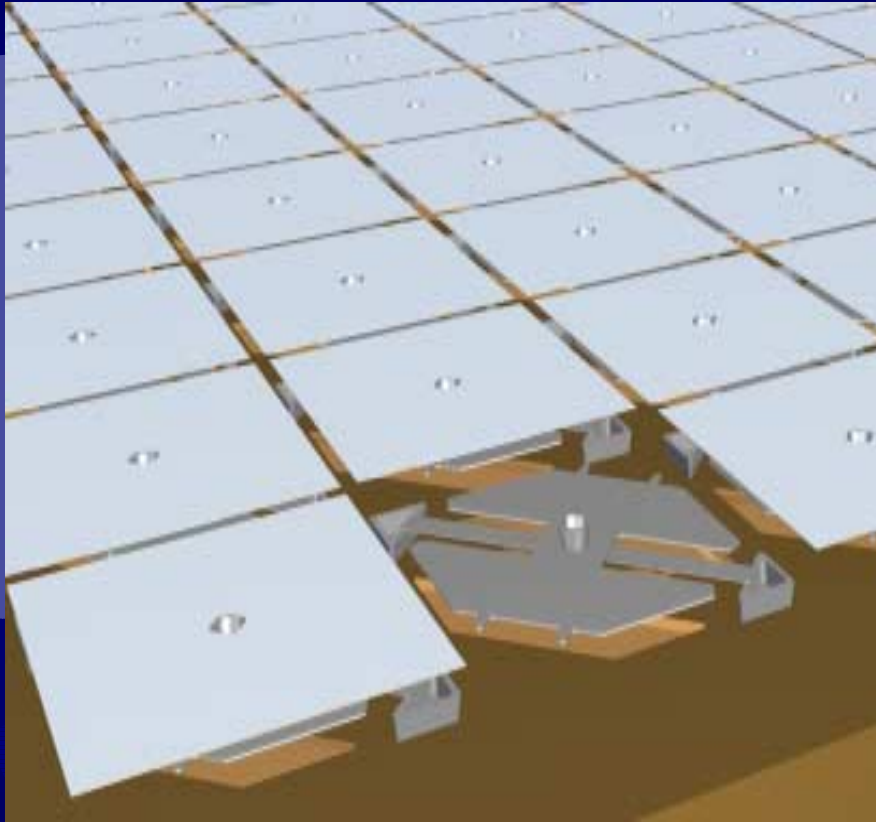
# Next Generation Space Telescope

The Detector Systems Branch of NASA, GSFC is in the process of developing and fabricating a two dimensional array of individually addressable micro-mirrors. These mirrors have  $50\mu\text{m} \times 100\mu\text{m}$  pixel size and are electrostatically actuated with tilting capabilities of  $\pm 10^\circ$ . They are supposed to be used as programmable slits in the Multi-Object-Spectrometer (MOS) for the NGST project. The efficiency of observation will be increased by a factor of 1000 using these MEMS devices as compared to a conventional non-MEMS based instrument.

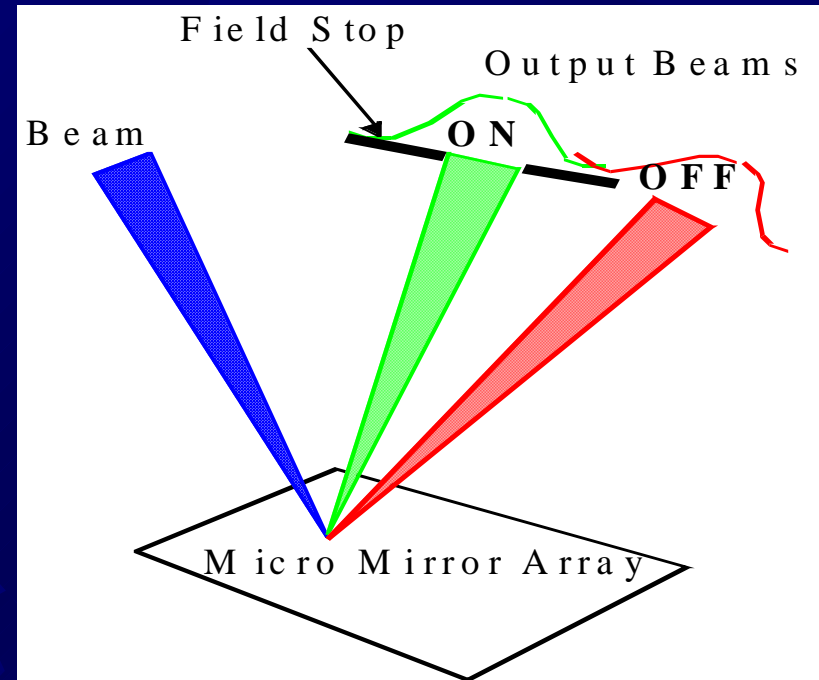


Artist's view of a micro-mirror

# Micro-Mirror-Array (MMA)



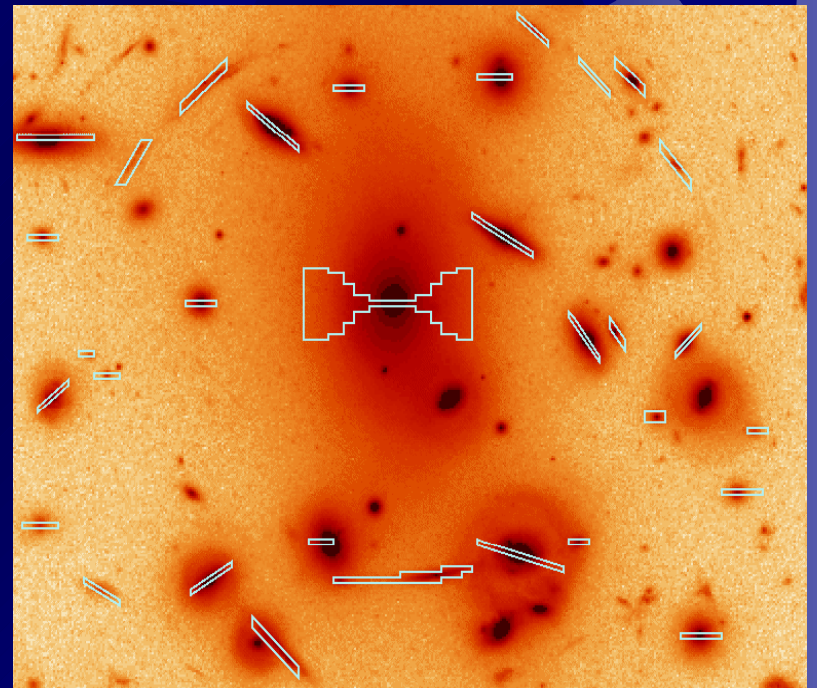
Artist's view of the MMA



Concept of MMA USE

# NGST MOS Applications

NGST, an 6.5 meter class telescope, will be launched in 2009. The MOS programmable slits will simultaneously select light from several Galaxies of interest and discard unwanted light from immediate neighbors.



# MMA, Fabricated at GSFC





# Material for MMA

To achieve best performance of the micro-mirror-array at cryogenic temperature (40K), Material Selection is important:

- ✱ High yield strength and elongation
- ✱ Properties at cryogenic temperature
- ✱ Thin-filmed Al or Al-alloy
- ✱ Little to no Cu in the alloy composition

# Sample Fabrication at DDL

## Sample Preparation Methods

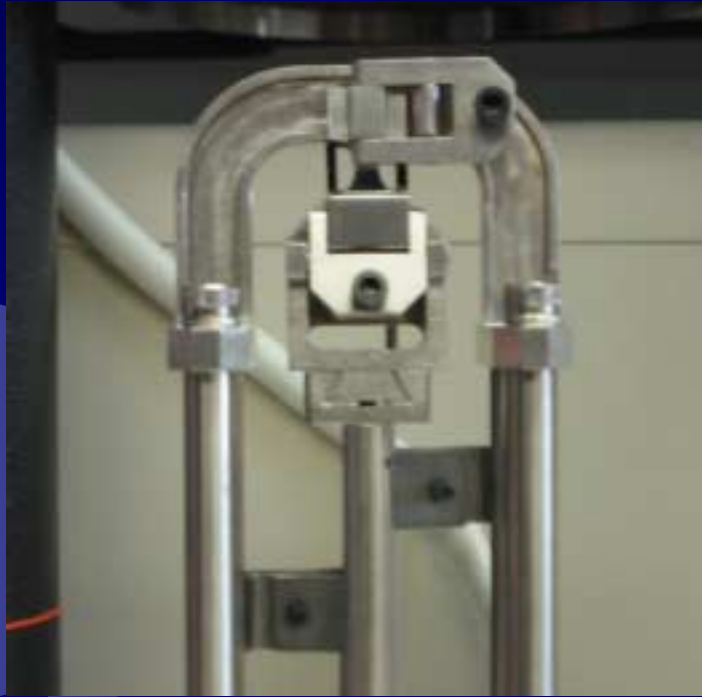
- ✦ Evaporation
- ✦ Sputtering
- ✦ Photolithography
- ✦ Metal etching
- ✦ Dicing of samples



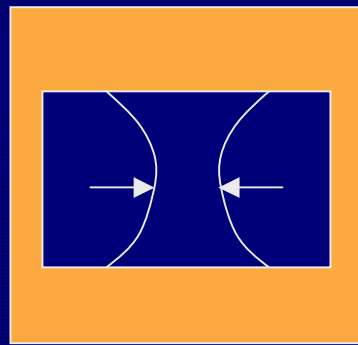
## Aluminum Alloys Used

- ✦ 1100 (Pure)
- ✦ 5052
- ✦ 5083
- ✦ 5086
- ✦ 6063

# Testing



Thickness:  $0.85\mu\text{m}$



L: 5mm

W: 3mm

Through close collaboration with the Material Science and Engineering Department at the University of Maryland and with the Materials branch at GSFC, sample preparation and tensile testing of the samples will be conducted using a Dynamic Mechanical Analyzer. By analyzing this new materials information with the Mechanical Systems Analysis and Simulation Branch, the best material for this application will be chosen.



# Recognition

- ✦ Mitra Dutta – Leader of MMA Project
- ✦ Tony Zheng – Detectors Branch
- ✦ Kiyotaka Mori – University of Maryland
- ✦ Charles He – Materials Branch
- ✦ Jim Loughlin – Mechanical Systems Analysis and Simulation Branch